

TELEPHONE CONVERSATION WITH DR. ROBERT LITWAK ON OCTOBER 3, 1974

Dr. D. Nice of you to call me back. Listen I called you for some information

Dr. L. All right, sire

Dr. D. In connection with all this left-heart bypass business that they are fussing with down here and, in my opinion, in a rather extravagant way, I listened to your man Mitchell talk out in Dallas.

Dr. L. Oh, yes, Ben Mitchell he was one of our pump technicians.

Dr. D. Yes, and I was fascinated with that and I wanted to know everything that I could learn about exactly what you were doing. Is it teflon tubes that you use?

Dr. L. We could send you one set if you will, but in any event let me tell you what they are.

Dr. D. Do you mind if I turn on a recorder so I don't have to ask you to say it over again?

Dr. L. No, not a bit. I only hope I can - can you wait a minute before you turn it on. I will get some notes--a little paper that we are sending in to the New England Journal. I originally sent them a paper--maybe I'll take the liberty of sending you the expanded paper. It was thirteen or fourteen pages and it went into the background including all the basic work by a fellow by the name of Dennis, et al and all of your boys and they just said it was too darn long. We had about 35 references so they said "We'll accept the paper, but you have to chop it from 15 or 14 pages to five and we won't take more than 12 references." So anyway we did chop it down and we sent it back them, but the essence of it is this,--I just for the moment want to be very clinical and please excuse me if I am anecdotal, but I guess this is the way it really happened, and I don't mean to abuse a great physiologist peer like you as well as surgeon, but this is literally the way it happened.

Some years ago, we had a patient on the pump who was very sick and I could gradually just almost get him off the pump, but I couldn't get him down--what I ended up doing was I put a little suction on the left atrium and at that time we were using the femoral artery and I got him down from a liter to 750 cc. left heart bypass and at 750 and 500 cc. it was just beautifully stable ~~without~~ ^{with} ~~mine~~; everything was perfect, but I just couldn't turn the machine off. Now I knew full well that the left ventricle was filled ~~with~~ and I was just unloading it just a little bit and I couldn't conceive that it was empty or that I was doing anything to ^{my} ~~my~~ O_2 measurably, but nevertheless here he was stable at that. Well I finally had to turn the machine off and I lost him. I kept thinking about that and thinking about and it happened again, maybe a couple of years later, and I figured that was it., I couldn't explain it physiologically, but it was perfectly apparent to me that if I could find some means of just supporting these characters a little bit, maybe, just maybe, I could pull some of my chestnuts out of the fire occasionally.

How to do it? Well, it seemed to me that the way to do it was obviously there was nothing new under the sun and the left heart bypass that you had developed and so many others, Dr. DeBakey and every man in his own little system. But the key to me was, how do I figure out how to do left heart bypass and, as you pointed out so many, many years ago, not reenter the thorax. Well, number 1, you could use the Dennis, et al technique with a transseptal approach, but

Dr. D. That's not good for a long time

Dr. L. Right, but the one was that I had an advantage that Dr. Dennis and his associates didn't have, I was in the chest. So, O.K., figure out a way of putting in a cannula ^{in that, sewing} cannula in the left atrium, and then obviously the thing to do was to find some method of making a precise obturator which could be slid in from let's say a subcutaneous position without--and therefore fill the lumen without--forgive for going through all this nonsense--

Dr. D. I understand that, I listened to Mitchell

Dr. L. O.K. Anyhow, maybe I'm going through too much nonsense, but I thought about it for a while and all of a sudden it occurred to me as we were doing these many transvenous pacemakers five or six years ago that good heavens, these patients tolerated the presence of silicone elastomer materials exceedingly well in an area where it could well be thrombogenic intravenous system. So I thought well, why don't we try this out in dogs and we spent a couple of years trying to work out precise cannulae and Bob ~~Koefsky~~ whom you may recall worked with Ed Leonard. Bob and I did this for a few years without too much success because they had to be absolutely precise and you had to figure out some way to obliterate the luminal cannula and present a smooth face to the blood. Well, finally we figured that out and then we tried some in dogs and we've now got dogs--in December why those dogs, we've got dogs with cannula in them now it will be for three years. With that as background you may recall I presented a little paper to ASAIO I guess a year and a half or so ago, I think, with about a year's followup of some of our canine experiments. Well, I was still hesitant to use it on patients, of course, and so we continued to do some more long term animals, but one day we had a patient who couldn't come off bypass and we, we couldn't use the balloon pump on him because we couldn't negotiate his iliacs. So there we were in a real jam, so we just couldn't get him off so we finally had to use the cannulae and we put them in and it worked beautifully. Here, let me read rather than wasting your time with my description. Here let me read the report. This was a sixty-six-year-old male with stage cardiac disease, Class 44, who couldn't be separated from conventional cardiopulmonary bypass following double valve replacement. Despite maximal adjuvant therapy we attempted multiply to insert two balloons but that was unsuccessful as indicated because of bilateral iliac arterial obstruction. So because of the desperate situation we then decided to implant the cannulae and establish partial bypass. We put the cannulae in and even then stability was probably

and even stability was probably achieved as the device took over circulatory support of the flow rate of 2800 ml per minute which when you calculate it out was 1.7 liter per square meter. And at that level of support the mean left atrial pressure fell from 32 to 12 millimeters of mercury and the mean systemic arterial pressure rose from 50 to 85 millimeters. And then we -- we reversed the heparin partially with a small amount of protomine -- 1 milligram per kilogram-- and then we used something that Don Hill had suggested to us, the activated coagulation time that Hattersley had described and that was a very simple way of keeping the patient slightly heparinized. At no time was there a real problem with inappropriate amounts of blood loss and then we kept him slightly heparinized at about--with an activated coagulation time 120 to 160 seconds using a drip infusion of heparin about 3 to 10 international units per kilogram per hour. Then we closed the sternum and moved him to the ICU with the heart assist device operating on battery power during the transfer.

Now, what was sort of interesting was that we maintained the device at that particular flow rate of 2800 ml per minute during the first six hours, and thereafter it was possible to gradually reduce the flow rate as cardiac performance improved. In the third hour in the ICU, which made it about five hours after the intracardiac repair we did some output and we documented that the AKD was providing 65 percent of total systemic blood flow. We calculate total systemic blood flow is whatever the doctor--the fraction of course is very simple;--the total systemic blood flow

Dr. Dr. Around five _____

Dr. L. So

Dr. D. What was the date of that patient?

Dr. L. The date of that patient was, I would guess.... The date was March 26, 1974.

Dr. D. He is the one that you had on 42-44 hours total.

Dr. L. Yes. Since then we have had another lady, I think we did a coronary bypass aneurism and she too could not have the balloon deployed and we ended up--we pumped her 67 hours and she's been dismissed from the hospital.

Dr. D. Mitchell mentioned that you had four patients before that one in March that didn't do well. What were the causes of death on those.

Dr. L. In any event, those are the two successful patients. All right now, we had had some situations where--I am speaking from no notes here now I am sorry--we had had some patients in whom - we had balloon pumped them and it was obvious that they -- we were getting nowhere, and we were not particularly happy about the cannulae at all, but again we had nothing to lose in those patients. They were obviously dying on us.

And again I don't have the specific in front of me and we were trying to accumulate the material to try to submit to the ATS for a review of this and hopefully a critical discussion of this thing if they would accept it. I think the very first patient we -- I could be wrong about this -- but one of the earlier patients was guy who had had severe coronary artery disease, severe aortic valve disease and I think had had a previous myocardial infarction, and we did him as a desperate valve replacement coronary bypass case and we -- I can't remember whether we put the balloon in and it was ineffectual and we then again I am afraid just pretty much as a last ditch measure instituted the device and it supported him well but he subsequently succumbed, but succumbed due to just a plain massive myocardial infarction.

There was another lady who had severe angina and had had coronary angiogram and the angios revealed that she could not have a coronary bypass because her vessels were so ratty. It was a patient of Dr. Leslie Cune and he asked us to do a bilateral internal mammary artery implantation, which we did and as soon as the chest was open -- I am sorry that is incorrect -- as soon as the first implant was performed, just as the hemostat if you will was in her left ventricular myocardium she developed ventricular fibrillation. We attempted to resuscitate her and couldn't and since we couldn't resuscitate her at all there was no point in trying a balloon so Dr. one of my associates, put in the cannulae, pumped her up and I don't have her data in front of me but she responded very favorably but --

Dr. D. Could you defibrillate her?

Dr. L. Yes. One of the -- I am sorry to say -- one of the men, one of the residents, it sounds terribly critical and I don't mean it that way, it's just my own inadequacies in not having left precise instructions, but in any event the following morning when I showed up and I suppose I should have slept there, but in any event things looked pretty good when I left so I went home and there was an ~~unattended~~ ~~incident~~ and the heart assist device had been turned down to 2-or 3-or 400 cc. from what it had been, which had been a couple of liters and by that time she was going into cardiogenic shock and we never got her out. That was error on my part as far as maintaining proper instructions, because when I left about 1 or 2 in the morning we were quite hopeful, but those were cases which I am afraid we probably didn't put the cannulae in until we felt the patient was literally finished and the reason for that was obvious. I was very reluctant to utilize literally untested ~~a~~ situation like that I obviously was well aware of the need to try to be as pure as Cesaer's wife, and I believe we tried very hard not to -- well I think we fulfilled the moral and philosophical requirements, at least I hope so. My mother who was a school teacher used to warn me and say "Robert, self-recommendation" Again I called the New England ~~Journal~~ before I put that together and the lady who is the editorial assistant said to me "No way can you give us extensive case reports on all of the material and expect to get it published." As a matter of fact, as I told you before, Dr. Ronald Malt will be back and he said he had to chop that one case report down. So what I had proposed to do would be to submit to ATS a complete analysis

--well I can't say a complete analysis, but an abstract of our experiences and if they allow us on the program then the paper there would allow us to expand on the areas where we think we have made mistakes and what we have learned, but whatever I have I'll send and I think the one thing I can do is get Dr. _____ to give us a brief summary of everyone of the six cases.

Dr. D. I'd love that. Then I would have good answers. What I am doing is using your work there without NIH support, is that correct?

Dr. L. May I develop that for a moment? A number of years ago we submitted a proposal to the Artificial Heart Program. Ed Leonard and I add that was turned down.

Dr. D. What year was that?

Dr. L. RFP NHI 69-4. And I guess there is no date there. We proposed this the notion that something less than left heart total by left-heart bypass might be helpful, but I think that when Ed tried to find out why it had been turned down one criticism I think was that were arguing with one of the sacred cows of cardiovascular physiology that something less than total left-heart bypass might be helpful and that might not have been the predominant reason why it was turned down. It might have been turned down because it was a lousy proposal, which I think is probably more to the point. But in any event to respond to your question, I felt so strongly about this based upon my clinical experiences, two of them, that I couldn't explain why it would work but I had the strongest possible feeling that if we could give that left heart 8 or 10 or 12 or 14 and 24 hours of partial support, just maybe it could improve, and there was data available. All you had to do is read a lot of the Dennis papers. After all Dennis found as I recall in one of those papers as little as 15 percent partial bypass reducing \dot{MVO}_2 a little bit. My argument is maybe we have been worshipping at the altar of the wrong God. I'm not so sure that--after all Clarence some of the other studies showed when you had total left heart bypass I think about 50 percent--there was a drop of about

Dr. D. That is right it was just about 50 percent.

Dr. L. Well, and at 50 percent left heart bypass Dennis and associates showed that there was about a 20 percent reduction in \dot{MVO}_2 . Well if you really think about it for awhile one could make the argument that there you are at 50 percent--well, we'll turn it around, at 100 percent of bypass left ventricular volume the heart is still using 50 percent of the basal oxygen just to stay alive and my argument is that we in essence are injecting energy into the system, that we are reducing freeloader a little bit and that we are--and then again your elegant studies showed that less with the angios showed that you could reduce the diastolic--reduce the radius of the left ventricle with partial bypass and that maybe, just maybe some of the applications _____ do apply. My argument and what I expanded on in the New England Journal went something like this. If further data bear out this, further clinical studies bear out the fact that partial bypass can be effective, then of course the implications are pretty substantial, because the design requirements

systems

for a little partial bypass/are very modest compared to total bypass systems. So, I'll send you the....

Dr.

Dr. D. All right I would appreciate it very much, indeed, and I appreciate all this right now, because this is..... I

Dr. L. I don't mean to sound graddiose

Dr. D. You say you have sunk your own money into developing this. Your own personal earnings?

Dr. L. Yessir.

Dr. D. O. K. I'll point that out too, if you don't mind.

Dr. L. No. not at all. I really believe that--I really believe in this concept. It is not as if we had anything unique to propose here. We just thought up a little method which I think keeps us from having to reenter the chest and also if it ever gets to be proven that it is a really a predictable system, it may well be that in some year to come a surgeon may say, "Well, since the low output may not appear until 24 or 48 hours later....he may decide if the cannulae are sufficiently good, and I think they are, he may decide that this patient may get into a jam and he'll put the obturator cannulae in and position them subcutaneously and later on if the patient does go into low output and the balloon doesn't hold it he can use the obturated cannulae. Now maybe that is blue-skying it and maybe it will never come to that. Right now I wouldn't think of putting it in for that purpose.

Dr. D. Has anybody gotten an infection around them?

Dr. L. No sir, and we have dogs now as I said in December -- they will be three years in December.

Dr. D. No infections in the dogs?

Dr. L. No sir.

Dr. D. What is the material out of which the....

Dr. L. It's simple. The cannulae themselves are made of silicone elastomer tubing and they have a little skirt on them, they are handsewn, they are dacron and we have sections on the animals--I think we have done it carefully and it's....the cannulae are just beautifully accepted and tolerated by the canines, by the dogs. Just beautifully. Perhaps I am wrong, but I can't remember an infection in the dog and of course we only have two clinical experiences which went long enough to create conditions where we might have had a problem clinically, namely the transcutaneous passage of tubing..... What we do by the way Clarence, we leave all the cannulae under the skin, we bring a loop of silicone elastomer tubing and connection underneath the skin, if you can picture that and then what we do when we connect them, we prep very carefully for a long period of time and, of course, I need not tell you that we very carefully drape it out before we move the

patient in every possible way trying to keep that skin almost surgically clean which we obviously can't do. But anyway we prep it very carefully for a long, long time and then make a small skin incision just in the right hypochondrium and well all of this will be described, but then maybe Ben showed you a picture. It is simple and I think the important thing is Clarence, that it doesn't require a lot of fancy, shnapsy equipment, I think any surgical group can use if they have the cannulae they can do this thing. Now what we are hoping to do if again if we had funding we would like to really understand what we are doing, physiology, of course, a lot of the work was done by Dennis, et al needless to say. We would like to try it in combination with aortic balloon pumping because obviously we would then not only be handling preload but also afterload. So I think that there are good questions to be asked.

Dr. D. Tell me, how do you attach that aortic catheter to the aorta? Is this in the ascending aorta?

Dr. L. Oh yes, let me

Dr. D. Is that the same site where you had had your return for the extracorporeal circulation?

Dr. L. No, because the patients we have used on we just couldn't we had to keep the pump going. What we did was we put this on lateral work. My first thoughts some years back were to use the abdominal aorta because I didn't like the---well, there are other thoughts, too, like catheters beyond the head vessels so we wouldn't get cerebral emboli if they were to occur, but we just couldn't work out an adequate cannulae for that. As I said we had other thoughts about using the abdominal aorta and approaching it not unlike the lumbar--an extra peritoneal lumbar sympathectomy sort of thing. We tried it on the dogs and it just didn't work too well and I thought that good heavens in a critically well patient you are going to have a real problem doing that and furthermore many of the patients who might require this might have a great deal of atherosclerosis in their abdominal aorta so we abandoned that idea and then I thought that this was a desperate situation right lateral law of the ascending aorta and I must say one of the gratifying things with using this activated coagulation system of Hattersly and I think Don Hill was the one who pointed this out to me the cerebral function of these people is as sharp as a dime, all of these people.

Dr. D. I appreciate your calling me and I appreciate you giving me all of this information and if I could have a copy of that paper that you sent to the New England Journal I would love it.

Dr. L. Well I am talking to the guy who put it all on the map and I really mean that Clarence. So Long Brother, Oh boy, you did it all Every time we decide to do something.....